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(54) Propeller shaft joints

(57) A propeller shaft for a motor vehicle, incorporates two elements 10, 11 interfitting axially with one another and deformed by dies 14, 15 to a torque transmitting cross-sectional shape so that frictional forces are sufficient to prevent relative axial movement in normal service. Under accident impact conditions the shaft is able to collapse axially and avoid the potentially dangerous consequences of acting as a rigid strut.

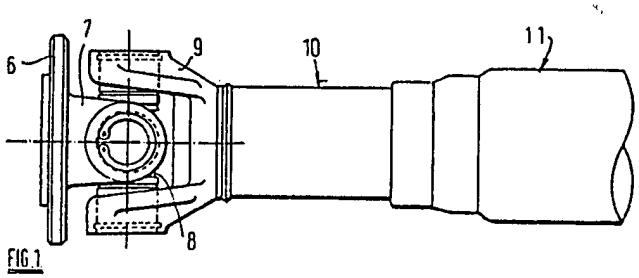

FIG.1

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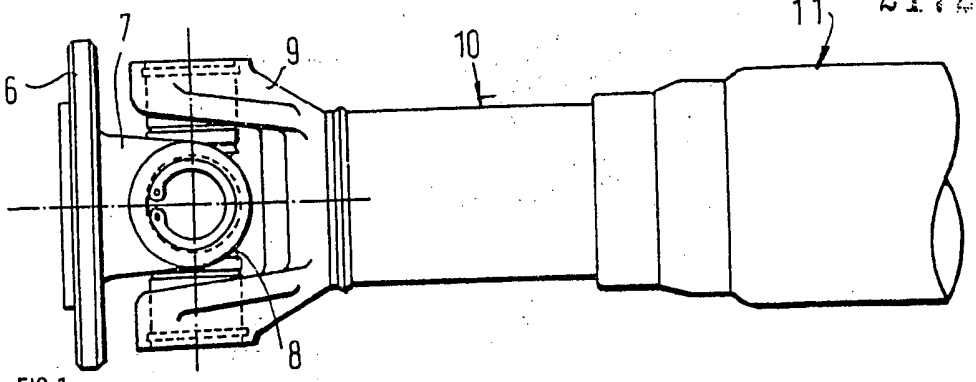

FIG.1.

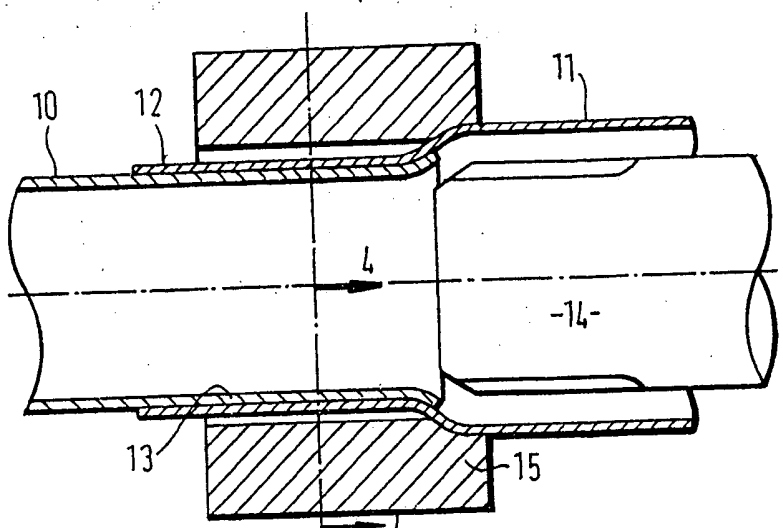

FIG.2.

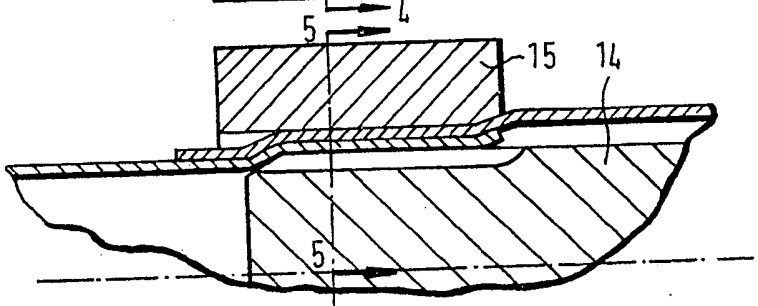

FIG.3.

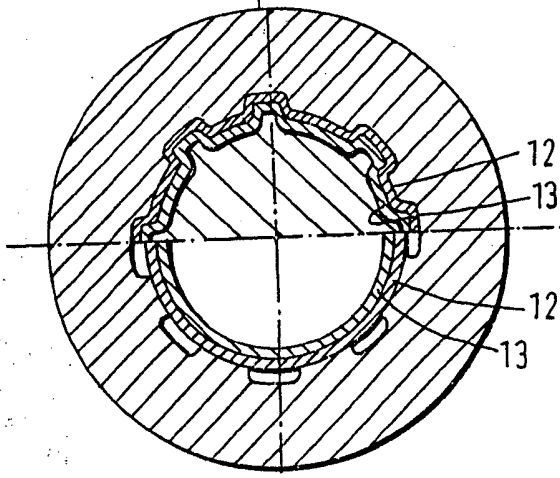

FIG.4.

SPECIFICATION

Propeller shaft for motor vehicle

This invention relates to a transmission shaft for use as the longitudinal shaft (usually, and herein, termed the propeller shaft) of a motor vehicle. Such a shaft is used for power transmission between a forwardly mounted engine unit and a rearwardly mounted differential gear unit, or gearbox and differential, in a vehicle.

It is usual to provide for a vehicle's propeller shaft to be capable of accommodating a relatively small change in the length of the shaft. Such a change in length is necessary to facilitate installation of the shaft and to accommodate geometrical changes with suspension movement and movement of the engine unit in service and may be provided by a sliding splined joint forming part of the shaft. If, however, the vehicle is invovled in an accident front and/or rear impact, the shortening of the shaft length allowed for in its design may be exceeded as the body structure of the vehicle collapses longitudinally. It will be appreciated that it is usual to design the body structure of some vehicles, particular modern passenger cars, to absorb impact energy by progressive collapse of the front and rear parts thereof. Under these circumstances, the propeller shaft will act as a rigid strut, with possible dangerous consequences. For example, it may puncture the vehicle's fuel tank, cause damage to fuel lines, possibly enter the passenger compartment of the vehicle, or cause the engine unit to be displaced in an undesirable manner such as to enter the passenger compartment of the vehicle.

Accordingly, it would be desirable if the propeller shaft were capable of axial collapse under such accident conditions, to avoid the above mentioned dangerous effects. The shaft should, of course, perform as an ordinary shaft in normal service. It is the object of the present invention to provide a propeller shaft which meets these requirements.

According to the invention, we provide a propeller shaft, comprising two tubular shaft elements having portions interfitting axially with one another and of a cross-sectional shape adapted to transmit torque therebetween, said portions having been deformed to said cross-sectional shape while in said axially interfitting relationship, whereby frictional forces therebetween are sufficient to prevent relative axial displacements under axial loads encountered in normal service.

If a vehicle having a shaft according to the invention is involved in an accident of sufficient severity to attempt to shorten the shaft, the probability is that the axial force exerted on the shaft will be sufficient to overcome the frictional force between the shaft elements, so that they will move axially relative to one another allowing the shaft to collapse.

The invention also provides a method of making a propeller shaft as above set forth.

The invention will now be described by way of example with reference to the accompanying drawings, of which:

Figure 1 is a diagrammatic elevation of a propeller shaft incorporating the invention;

Figure 2 is a longitudinal section illustrating a first stage of manufacture of a shaft according to the invention;

Figure 3 is a partial section as Figure 2, showing a second stage in manufacture;

Figure 4 is a composite section, partly on the line 4–4 of Figure 2 and partly on the line 5–5 of Figure 3.

Referring firstly to Figure 1 of the drawings, there is shown part of a propeller shaft including a Hookes joint with a driving flange 6 and two yokes 7, 9 connected for torque transmission and relative articulation by a cross member 8. Yoke 9 is welded to a tubular shaft element 10, which in turn is connected by a torque transmitting connection as hereafter described to a further tubular shaft element 11.

Referring now to Figure 2 of the drawings, this shows the connection between tubular shaft elements 10, 11. The shaft element 11 terminates in a portion 12 of reduced diameter within which an end portion 13 of the shaft element 10 is a close fit. At their other ends, not shown, the shaft elements 10, 11 would be adapted to have suitable torque transmitting components fitted to them, e.g. universal joint parts.

To connect them for torque transmission, the shaft portions 12, 13 are provided with an interfitting transverse cross-sectional shape. This shape, which in the illustrated embodiment comprises interfitting splines, is provided by deformation of the portions 12, 13 while interfitted with one another. This deformation may be carried out by an internal punch 14 and an external die 15 of annular configuration. In Figure 2, the punch and die are shown in position ready for use, and in Figure 3 after they have been moved axially together to deform the shaft portions 12, 13. The interfitting shape of the portions 12, 13 after such deformation is shown in the upper half of Figure 4 of the drawings. It will be appreciated that, provided the portions of the shaft elements interfit for torque transmission, other cross-sectional shapes than the interfitting splines illustrated could be utilised.

Because the portions of the shaft elements have been deformed together to establish the torque transmitting shape, frictional forces therebetween will be relatively great and should be sufficient to prevent relative axial movement between the shaft elements under axial forces encountered in normal service. Thus, in normal service the sliding splined joint which is normally incorporated in a propeller shaft will accommodate any geometrical changes requiring variation of the shaft length. If, however, an accident occurs such that the axial rigidity of the shaft may be a problem, the forces should be sufficient to overcome the frictional forces acting between the portions 12, 13 of the shaft element, so that the shaft collapses axially. Thus the potentially dangerous consequences of the shaft acting as a rigid strut are avoided.

It will be appreciated that techniques other than the use of a punch and die illustrated may be used to impart the torque transmitting cross-sectional shape to the portions 12, 13 of the shaft elements. For example, a rolling technique could be utilised.

CLAIMS

1. A propeller shaft, comprising two tubular shaft elements including portions interfitting axially with one another and of a cross-sectional shape adapted to transmit torque therebetween, said portions having been deformed to said cross-sectional shape while in said axially interfitting relationship, whereby frictional forces therebetween are sufficient to prevent relative axial displacements under loads encountered in normal service.

2. A shaft according to Claim 1 wherein said portions are provided with interfitting splines for said torque transmission.

3. A method of making a propeller shaft, comprising assembling two tubular shaft elements with portions interfitting axially with one another, and deforming said portions of the shaft element while thus assembled to impart to them a cross-sectional shape adapted to transmit torque therebetween and to establish a condition whereby frictional forces therebetween resist relative axial displacement under axial loads encountered in normal service.

4. A propeller shaft substantially as hereinbefore described with reference to the accompanying drawings.

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